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Art. III.—*Some Trematode Parasites on the Gills of Victorian Fishes.*

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(With Plates VIII.-XI.)

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This work was carried out under the guidance of Dr. O. W. Tiegs, and my thanks are due to him for his assistance and interest.

Methods.—The material was fixed in 1% formalin. Bouin, Zenker, and corrosive sublimate were also tried, but the formalin proved most satisfactory. Iron haematoxylin was used for all sections, and Erhlich's haematoxylin for whole specimens. In cases where the iron haematoxylin overstained the vitellaria in sections, Erhlich was used as an alternative.

Genus Anchylodiscus Johnston and Tiegs, 1922.

Anchylodiscus gadopsis, n. sp.

(Plate VIII., Fig. 1; Pl. X., Fig. 6.)

Found in great numbers on the gills of *Gadopsis* sp. (River Black Fish).

Locality.—Campaspe River, Vic.

Formalinised animal measures about 0·36 mm. in length, breadth 0·08 mm.

External Features.—Small body, slightly oval in section, with indication of head at anterior end; at posterior end is a well-marked hooked disc. The hooks are arranged in nine pairs, two consisting of large hooks, the bases of which are slightly bifurcated, and are connected by a single crossbar, while seven consist of minor hooks, one pair of which lies across one of the crossbars. The large hooks are supported by a ring of chitinous material (Pl. VIII., Fig. 1). Immediately in front of the pharynx there are two pairs of eyes, of which the anterior pair is the smaller.

Three pairs of "head organs" are present (Pl. VIII., Fig. 1); the cephalic glands are situated slightly anterior to the eyes.

The "brain" lies between the eyes, and is the only indication of the nervous system.

Alimentary Canal.—The mouth is situated ventrally, and is anterior to the eyes. The pharynx is large, intestine is bilobed

and devoid of caeca and ends blindly towards the posterior end of the body.

Reproductive System.—The testis is slightly elongated, lies dorsal to the ovary (Pl. X., Fig. 6), and extends posterior to it. The vas deferens passes forwards dorsally as a very wide tube, and opens posterior to the pharynx by a chitinous penis, which is a straight-pointed structure (Pl. VIII., Fig. 1).

The ovary is a large median structure, situated about half-way along the length of the animal. The oviduct passes forwards and opens to exterior close to the male opening. There is no vagina. The vitelline system is very large, and occupies the larger part of the body. The transverse yolk duct passes across anterior to the ovary and opens into the oviduct.

The egg is enormous, the ripe egg in the oviduct displacing the organs of the body.

Points by which *A. gadopsis* is distinguished from *A. tandani* T. H. Johnston and O. W. Tiegs (8) :—

1. One pair of minor hooks lies across one of the crossbars in a median position (Pl. VIII., Figs. 1, 2).
2. No vesicula seminalis could be determined. The time of the season may account for this.
3. The penis is straight instead of curved.

Genus **Squalonchocotyle** Cerfontaine, 1898.

Squalonchocotyle antarctica, n. sp.

(Plate IX., Figs, 4, 5; Text-Fig. 1.)

This marine parasite belongs to the sub-family Onchocotylinae Cerfontaine (7), of the family Octocotylidae van Ben et Hesse (3). It is very similar to *S. vulgaris* Cerfontaine (7), and *S. grisea* Cerfontaine (7). Found on the gills of *Mustelus antarcticus*.

Locality.—Port Phillip Bay.

Average length of formalinised animal 10 mm., breadth 1 mm.

External Features (Pl. IX., Fig 4).—Body elongated and flattened dorso-ventrally. At the posterior end is a fixing organ which is composed of a fixing disc with a caudal appendage. On the former are three pairs of large suckers arranged in two parallel rows and each provided with a single large hook. Two smaller, unarmed suckers are present at the extremity of the caudal appendage, and a pair of small minor hooks is situated between them. The body is attached to this organ at the level of the middle pair of large suckers.

Each large hook ends in a small pointed structure which is recurved at right angles, and sharply defined from the main body of the hook by its smaller diameter. The minor hooks are Y-shaped, the three arms being more or less equal, and the base of

the Y ends in a small hook which is recurved so as to point in a direction parallel to the long axis of the hook (Text-fig. 1*a*, 1*b*).

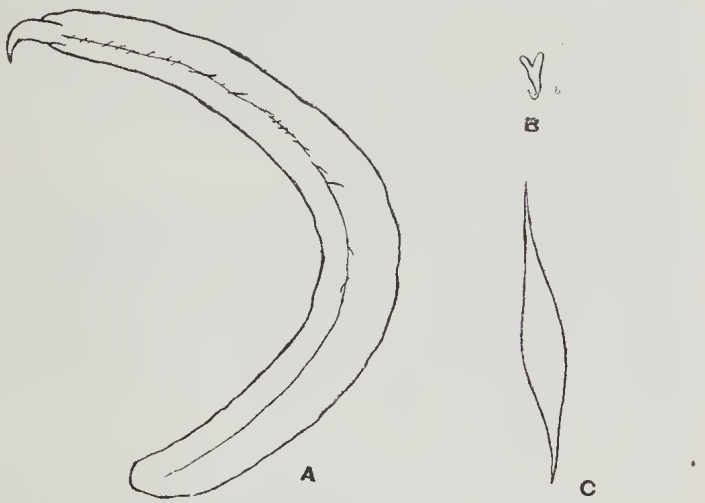

Fig. 1.—*Squalonchocotyle antarctica*, n. sp., drawn with camera lucida. A, major hook; B, minor hook; C, egg.

Alimentary Canal.—The mouth is situated ventrally, and is surrounded by a large circular sucker; a short muscular pharynx opens into the œsophagus, which divides immediately into the two main branches of the intestine. These unite at the posterior end of the body, and pass into the fixing organ. Here the intestine divides again into two single branches passing anteriorly and posteriorly along the disc and caudal appendage respectively. Small unbranched caeca are given off both medially and laterally along the length of the intestine.

Reproductive System (Pl. IX., Fig. 5).—The reproductive organs are typical of the sub-family. The common genital opening is median, and is situated just posterior to the pharynx. The two vaginal openings are lateral, and on nearly the same level as the genital opening.

The eggs are oval and narrow, with two short polar filaments. The length of the egg is approximately 150 μ, which is roughly twice the length of the filaments (Text-fig. 1*c*.).

S. antarctica is distinguished from *S. vulgaris* by the following points:—

1. Shape of buccal sucker.
2. Shape of minor hooks.
3. Length of polar filaments of egg.

S. antarctica is distinguished from *S. grisea* by the following points:—

1. Structure and shape of large hooks.
2. Position of vaginal openings.

Macrophylla, n. gen.

MACROPHYLLA ANTARCTICA, n. gen. et sp.

(Plate X., Figs. 7-9.)

Marine form from the gills of *Mustelus antarcticus*. Found on only two specimens of about a hundred examined.

Locality.—Port Phillip Bay.

Length of formalinised animal 13·15 mm., breadth 1·3-2·5 mm.

External Features (Pl. X., Fig. 7).—At the anterior end on either side is a single pair of large flat expansions, ridged on their ventral surface. Sections of these structures, examined under high magnifications, seem to reveal them as glandular in nature. At the hinder end is a large disc, attached by its middle to the body of the worm (Pl. X., Fig. 7). This disc is provided with a very large sucker, divided by radii into five secondary suckers, of which the largest is incompletely divided into three compartments.

Body Wall (Pl. X., Fig. 9).—This consists, so far as could be made out on the material available, of an epidermis with a marked cuticle. The musculature consists of a circular layer divided into three secondary layers, a well defined longitudinal layer, and vertically running fibres.

Alimentary Canal.—The crescent-shaped mouth opens into an enormous pharynx, which extends well over half the breadth of the animal. The pharynx is extremely muscular, and is provided with large unicellular glands. The intestine is bifurcated, long and narrow, and extends almost to the posterior end of the worm. Along its length numerous branching caeca are developed.

Reproductive System (Pl. X., Fig. 7, 8).—There are two compact testes situated behind the ovary, about a third of the length of the animal from the anterior end. The left testis is situated a little in front of the right. The two vasa deferentia lead into a common tube which travels to the left of and dorsal to the ovary. It then passes forwards almost to the level of the reproductive openings, crosses under the vagina, turns back upon itself and enters the penis. This is a pear-shaped muscular organ, which passes to the exterior along a narrow duct whose opening is situated on the side of the animal just behind the left glandular expansion, and immediately anterior to the uterus.

The ovary is a well-marked, median, round body, considerably larger than the testes. The oviduct passes forwards as a straight tube and continues as the uterus to open just behind the male opening. The vitelline glands extend along either side from the anterior to almost the posterior end of the body. The two longitudinal yolk ducts open into a transverse duct, which runs anterior to the ovary, and opens into a dilated short median yolk-duct, which in turn opens into the oviduct. The vagina has a

common opening to the exterior with the male duct. It passes behind into a curious muscular organ (Pl. X., Fig. 8), which in turn opens into a slightly convoluted tube, leading backwards and emptying into the transverse yolk duct. The muscular organ above referred to, and the proximal part of the convoluted tube which leads away from it, lie suspended in a cavity, indicating that they are distensible structures. It is probable that the tube is a receptaculum seminis, though I have never observed spermatozoa within it.

In two specimens an egg was present in the uterus; it is oval in shape, and measured about 220 μ in length, 107 μ in breadth. The genus *Macrophylla* is distinguished from its nearest ally *Tristomum* by the following points:—

1. Two compact testes as contrasted with numerous testicles.
2. Only five instead of seven distinct radii in posterior sucker.
3. Glandular membranes at anterior end in the place of suckers.

Genus Octobothrium Leuckart, 1827.

Octobothrium thyrites, n. sp.

(Plate XI., Figs. 10-12; Text-Fig. 2.)

Marine form found on gills of *Thyrites atun* (Barracouta).

Locality.—San Remo, Vic.

Length of formalinised animal 7-8 mm., breadth 2-2·5 mm.

External Features (Pl. XI., Figs. 10, 11).—Body elongated and flattened dorso-ventrally, tapering forwards each end; it is more pointed anteriorly. A distinct "head" region is marked off anteriorly by the two lateral openings of the vagina which are surrounded by tumid lips. Posterior end terminates in a fixing disc which is not sharply defined from the body. Disc is provided with eight suckers arranged in two rows converging posteriorly, and each sucker has a complex armature (Pl. XI., Fig. 11, and Text-fig. 2*a*). Two pairs of small hooks are situated at the extreme posterior end, the more anterior pair being the larger (Text-fig. 2*c*). In the "neck" region the body wall is so folded as to give a false appearance of segmentation. (Pl. XI., Fig. 10).

Body Wall.—This consists of a syncytium with a marked cuticle. The musculature consists of a thick layer of well developed longitudinal fibres, the circular fibres being only poorly developed.

Alimentary Canal.—The mouth is situated on the ventral side of the extreme anterior end. On each side of the mouth is a pair of small oral suckers, which is characteristic of the group. The mouth leads into a wide, but not muscular pharynx, opening into the intestine, which forks immediately posterior to the transverse vaginal duct. Numerous diverticula are given off along the whole length of the intestine, both medially and laterally.

Reproductive System (Pl. XI., Fig. 12).—The male organ is represented by numerous testicles occupying the middle of the posterior 3/5ths of the body. The single vas deferens passes up medially and dorsally as a coiled tube, and opens to the exterior on the ventral surface of the "head" by a sucker which is surrounded by small hooks (Pl. XI., Fig. 12, and Text-fig. 2*b*).

The ovary is lobed and single, situated on the right side about 2/5ths of the total length from the anterior end. In stained specimens a lobed structure (Pl. XI., Fig. 10, *y.o*), which takes up the stain very readily, appears in sections to be composed of young ova. There is some doubt about this, as similar stained cells extend from this structure to the posterior end of the body.

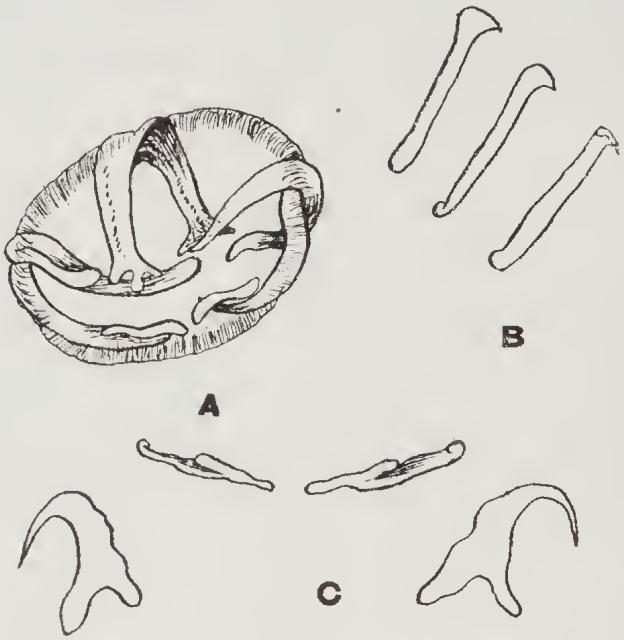

Fig. 2.—*Octobothrium thyrites*, n. sp., drawn with camera lucida. A, armature of posterior sucker; B, hooks of genital apparatus; C, hooks at posterior extremity.

The ovary, however, appears to be continuous with the lobed portion. The oviduct passes forwards dorsally, the shell gland opens into it immediately posterior and dorsal to the yolk reservoir. It continues forwards ventrally as the uterus to open posteriorly to the male genital opening. The vitelline glands extend along either side from the "neck" to the posterior end of the body. The longitudinal ducts open into a large transverse yolk duct which opens medially into the yolk reservoir, to the right of which lies the ovary. A single yolk duct passes down and opens into the oviduct. Laurer's canal is clearly seen as a narrow tube

running from the junction of the oviduct and vitelline duct to the intestine. The two vaginal openings are connected by a single transverse duct, from the centre of which a single duct passes down on the right hand side to open into the double receptaculum seminis (Fig. 12). From this a narrow duct passes down and opens into the transverse yolk duct on the right. By this arrangement, sperm not used in fertilisation may be passed into the intestine. In fact, I have observed in sections structures which closely resemble sperm together with yolk granules in Laurer's canal.

History.—Hermann in 1782 was the first to describe a worm of this group. Then in 1828, Leuckart, and later Kuhn, described the same species. At first the posterior end was taken for the anterior end, and vice-versa.

I have followed Bronn's classification, which gives the following synonyms for *Octobothrium:—Dactylocotyle, Choriocotyle, Pterocotyle, Glossoctyle, Octocotyle, Ophiocotyle* and *Octosoma.*

Of the previously described species I have not been able to obtain the literature describing—*O. lanceolatum, O. sagittatum,* and *O. arcuatum.*

O. thyrites is distinguished from *O. thunninae* by the following points:—

1. The arrangement of the suckers on the posterior disc.
2. The posterior disc is not divided from the body by a constriction.
3. The intestine is forked below, not above, the sexual openings.
4. The genital armature is distinctive in both species.

Genus Ancyrocephalus Creplin, 1839.

(Syn. *Diplectanum* Diesing, 1858). (MacCallum 9.)

Ancyrocephalus bassensis, n. sp.

(Plate VIII., Fig. 3.)

Marine form found in great numbers on the gills of *Platycephalus bassensis* (Flathead).

Locality.—Port Phillip Bay.

Length varies considerably; formalinised animal, measuring 0·49 mm. to 0·95 mm.; average breadth 0·09 mm.

External Features.—Body elongate and circular in section. At the anterior end there is a slight indication of a "head" region; at the posterior end is a fixing disc which is not sharply marked off from the body. The disc is armed with nine pairs of hooks, consisting of two large pairs, the bases of which are bifurcated and connected by two cross bars, and seven minor pairs (Pl. VIII., Fig. 3).

Musculature.—This consists of an inner and outer longitudinal layer, with a circular layer between them. The longitudinal layer at the posterior end is strongly developed to supply the disc. Three pairs of head organs and numerous cephalic organs are present, the latter being arranged laterally and extending from the anterior pair of eyes to the region posterior to the pharynx.

Alimentary Canal.—The mouth is situated on the ventral surface in the "head" region, and opens into a very muscular pharynx. This opens into a short oesophagus, passing into the simple forked intestine which ends blindly at the posterior end of the body, and is devoid of caeca.

Reproductive System.—The position of the testis and ovary varies according to the degree of contraction of the animal. The testis is a single large rounded structure taking up the whole of the diameter of the body and lies immediately posterior to the ovary. A single vas deferens is given off anteriorly on the left, and passes forwards ventrally to a large vesicula seminalis, opening to the exterior by a chitinous penis. A well marked prostate gland lies to the left of the penis, into the base of which it opens (Pl. VIII., Fig. 3).

The ovary is much smaller, and lies dorsally and anteriorly to the testis. The oviduct is short, and passes forwards as the uterus to open to the exterior with the vas deferens at the common genital opening which is median and ventral in position. The vagina is very short, and opens on the left just anterior to the ovary; it connects with the receptaculum seminis which is globular in shape, before passing immediately into the genital junction. The vitellaria are well developed, extending along the lateral margins, and the transverse yolk duct passes across anterior to the ovary.

I have found no reference to any other description of this genus occurring on Australian fishes.

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EXPLANATION OF PLATES.

Plate VIII.

Fig. 1.—*Anchylodiscus gadopsis*, n. sp. Entire animal, ventral view.
Fig. 2.—*A. tandani* Johnston and Tiegs. Disc in ventral view (from T. H. Johnston and O. W. Tiegs (8)).
Fig. 3.—*Ancyrocephalus bassensis*, n. sp. Entire animal, ventral view.

Plate IX.

Fig. 4.—*Squalonchocotyle antarctica*, n. sp. Entire animal, ventral view.
Fig. 5.—*S. antarctica*, n. sp. Longitudinal section.

Plate X.

Fig. 6.—*Anchylodiscus gadopsis*, n. sp. Transverse section, showing the relative position of ovary and testis.
Fig. 7.—*Macrophylla antarctica*, n. gen. et sp. Entire animal.
Fig. 8.—*M. antarctica*, n. gen. et sp. Reproductive organs, slightly diagrammatic.
Fig. 9.—*M. antarctica*, n. gen. et sp. Section through body wall, highly magnified.

Plate XI.

Fig. 10.—*Octobothrium thyrites*, n. sp. Entire animal with alimentary canal drawn on the right side only, and vitellaria on the left side.

Fig. 11.—*O. thyrites*, n. sp. Posterior end, highly magnified.
Fig. 12.—*O. thyrites*, n. sp. Reproductive organs, slightly diagrammatic.

Explanation of Lettering.

a.s. Sucker with chitinous armature; *b.* "brain"; *b.c.* Buccal sucker; *c.* cuticle; *c.a.* caudal appendage; *c.b.* cross-bar; *c.g.* cephalic glands; *c.g.o.* common genital opening; *c.m.* circular muscle layer; *d.m.* disc muscle; *d.s.* double sucker; *e.* eye; *eg.* egg; *ep.* epidermis; *g.o.* genital openings; *h.o.* "head organ"; *i.* intestine; *i.c.* intestinal caecum; *l.c.* Laurer's Canal; *l.h.* major hook; *l.m.* longitudinal muscle layer; *m.* mouth; *o.* oviduct; *oe.* oesophagus; *o.s.* oral sucker; *ov.* ovary; *p.* penis; *p.g.* prostate gland; *ph.* pharynx; *p.i.* part of intestine; *p.s.* posterior sucker; *r.* radius; *r.s.* receptaculum seminis; *s.* sucker; *s.g.* shell gland; *t.* testis; *t.s.* testicles; *t.y.d.* transverse yolk duct; *u.* uterus; *v.* vitellaria; *v.d.* vas deferens; *vg.* vagina; *vg.o.* vaginal opening; *v.s.* vesicula seminalis; *y.g.* yolk glands; *y.o.* young ova; *y.r.* yolk reservoir.